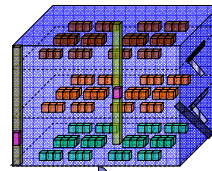


THE ANALYSIS OF VARIABLES WHICH INFLUENCE RENT-VALUE OF UNITS ON MULTI-LEVEL COMMERCIAL BUILDING BASED ON 3D NETWORK DATA STRUCTURE



Authors:
 1. Dr. Bambang Edhi Leksone
 2. Mr. Andri Hernandi
 3. Mr. Liber Sinaga

Representation of 3D unit Spatial Relation



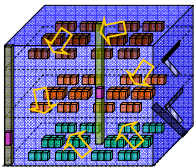
- The limited supply of land, causes an inefficient horizontal commercial building to be built rather than the vertical one (**Multi-Level**).
- The fact, now can be seen by a lot of business units have been emerging in multi-stories building (**Multi-Unit**)



- ☑ The 3D objects presented as 2D projections in Geographic Information Systems (GIS) may loose some of their properties and spatial relationships to other objects (Billen dan Zlatanova, 2003)

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

3D Spatial Relationship influences the unit value

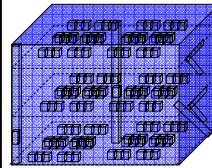


- Value of sell/rent business unit per meter square on multi-level commercial building is not the same to unit which located in floor differ or different location although they was made from the same material.
- Vernor and Rabianski (1993) believe that value of business unit on multi-level commercial building influenced by the unit's location factor.

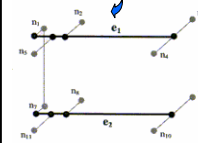
● **Physical factor variable is easy to identify but location factor variable needs 3D spatial relationship analysis.**

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

3D Model for variable identification



- Yasin's research (2004) is to identify the location factors variable with spatial queries from wireframe 3D model of building units. *In fact, the identification of location variables are not fully based on the 3D model*



- 3D Network Data Structure is a correct data structure that makes an analysis of unit connectivity relationship for stories buildings become easy. (Lee,2001)
- 3D Network Data Structure can be used for analyzing the 3D spatial relationship of unit connectivity and identifying factors of unit location.

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Problem Statement

Problems

1. Location and Physical unit factor variables are influence the value of selling and renting.
2. The ability of unit location factor variable identification depends on 3D spatial units relationship that currently used.

Limitations :

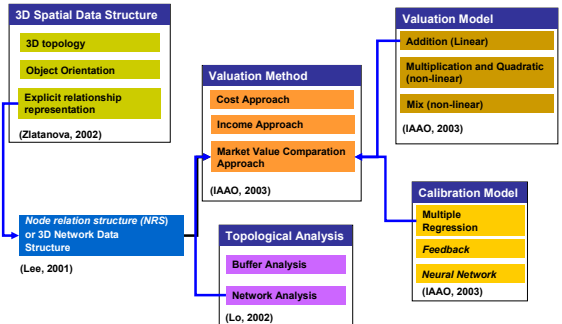
1. Location factor variables can be identified with data structure of 3D network.
2. Commercial property value predicted is commercial rent value
3. 3D spatial relationship unit model in commercial stories building is represented by 3D network data structure.

Questions:

1. How to build data structure of 3D network, which represents the topological relationships of units on multi-level commercial building?
2. What is the possible variable of location factor that influence the unit's of rent/sell value on multi-level commercial building?
3. How to identify the variable of location factor from 3D network data structure?

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Concept



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Research's Purpose and Benefit



The Purposes :

1. Obtaining most influencing spatial relationship to rent-value units.
2. Obtaining model to predict rent value unit.
3. Obtaining spatial unit relationship for visualization in multi-level commercial building with 3D network data structure.

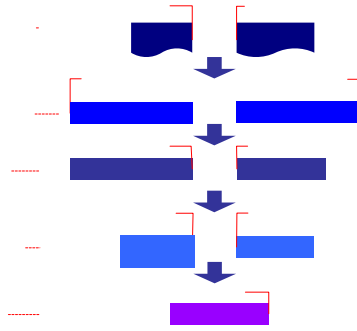
The Benefits

1. Besides giving an alternative technique in visualizing room units on multi-level commercial building data structure of 3D network also gives amenity and speed of identification of factor location.
2. Alternative of assessment method (comparative method) in assessment studies especially to assess business units on multi-level commercial building.



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Research Method



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Hypothesis



ASUMPTIONS :

Units

- a. **Space units, Escalator, Elevator** : represented by node at the center of its polygon on the floor
- b. **Escalator** : represented by node at start or end of its escalator polygon on the floor
- c. **Corridor** : represented by node at the center of its corridor polygon

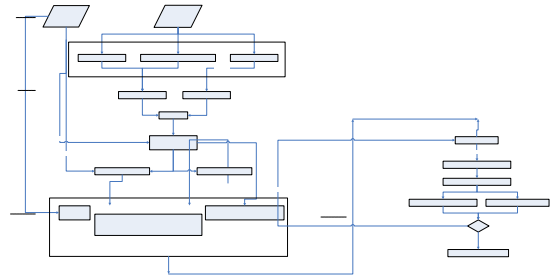
Variables

- Wide of unit (physical factor) has positively affected
 - Amount of access (physical factor) has positively affected
 - Floor level (location factor) has negatively affected
 - Closest Distance to Entrance (location factor) has negatively affected
 - Closest Distance to Elevator (location factor) has negatively affected
 - Closest Distance to Stairway (location factor) has negatively affected to rent value of unit.
- **Reaching-distance** relationship among units has more influence to rent value rather than **Reaching time**.
 - The Relationship of Rent-value and variables above are linear.



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Research's Flowchart

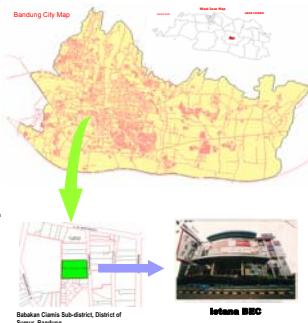
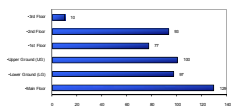


Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Research's Object



Research's object is the bussiness units in *Istana Bandung Electronic Center (BEC)* Building, Purnawarman street number 13-15 Bandung City.



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Unit Polygon Representation (node)



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Corridor Polygon Representation (center line)

Start/end point

Junction point

Normal point

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Linkage node unit to corridor's center line

Corridor's Centerline

Link line

Link node

Unit's node

Centerline's node

Node Projection principle is centerline and if node projection ≤ 0.5 m from centerline node then node unit linked to its centerline

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

2D network data structure

[Nodes]
Id_Node, X, Y, Z, Attribute
1, 0.5, 4.8, 5, elevatorL1t
2, 3, 5, Escalator 1st Floor
3, 1.5, 3.5, Stair 1st Floor
4, 3, 2, 5, Entry
5, 1, 0.7, 5, toilet

[Topology]
From, To, Cost_FT, Cost_TF
1, 5, 12, 12
5, 7, 15, -1
7, 8, -1, 15
7, 9, 15, 15

Data Storage

| Id_Node | X | Y | Z | Attribute |
|---------|-----|-----|---|---------------------|
| 1 | 0.5 | 4.8 | 5 | elevatorL1t |
| 2 | 3 | 5 | | Escalator 1st Floor |
| 3 | 1.5 | 3.5 | | Stair 1st Floor |
| 4 | 3 | 2 | 5 | Entry |
| 5 | 1 | 0.7 | 5 | toilet |

Each node has an identifier (Spatial ID), coordinate (X, Y, Z) and unit addresses information. Each connective line has a weight. The Weight relation between nodes is usually known as cost. The cost between nodes are not similar but depended its direction. After finishing all link of nodes to centerline corridor hence data structure of network 2D have been formed

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

3D network data structure and visualization

3D Network Structure

Nodes

| Id | X | Y | Z | Attr |
|----|---|---|---|------|
| 1 | 1 | 1 | 1 | L1 |
| 2 | 2 | 3 | 1 | Ex1 |
| 3 | 1 | 1 | 2 | L2 |
| 4 | 2 | 3 | 2 | Ex2 |
| 5 | 1 | 1 | 3 | L3 |

Topology

| From | To | Cost_FT | Cost_TF |
|------|----|---------|---------|
| 1 | 2 | 1 | 5 |
| 2 | 4 | -1 | 6 |
| 3 | 6 | 3 | 5 |

Data structure of network 3 dimension formed by link each pair of vertical conduit (elevator, escalator and stairway) nodes.

Algoritma visualization

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Network Valuation and shortest path

path analysis - shortest path (entrance 2 BEC to L2/A-05)

shortest path analysis - fastest path (entrance 2 BEC to L2/A-05)

Shortest path using dijksra algoritma

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|-----|----|----|----|----|
| 1 | 0 | 100 | 40 | 50 | 30 | 40 |
| 2 | 0 | 0 | 20 | 50 | 40 | 40 |
| 3 | 0 | 0 | 0 | 50 | 30 | 30 |
| 4 | 0 | 0 | 0 | 0 | 30 | 0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 |

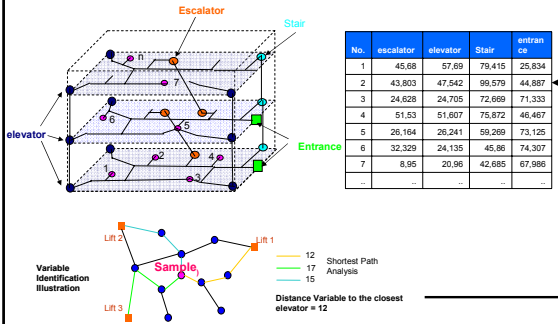
| From | To | Shortest Path | Distance |
|------|----|---------------|----------|
| 1 | 2 | 1-2 | 100 |
| 1 | 3 | 1-4-3 | 90 |
| 1 | 4 | 1-4 | 40 |
| 1 | 5 | 1-4-5 | 70 |
| 1 | 6 | 1-4-5-6 | 100 |

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Distribution data of Rental-unit sample

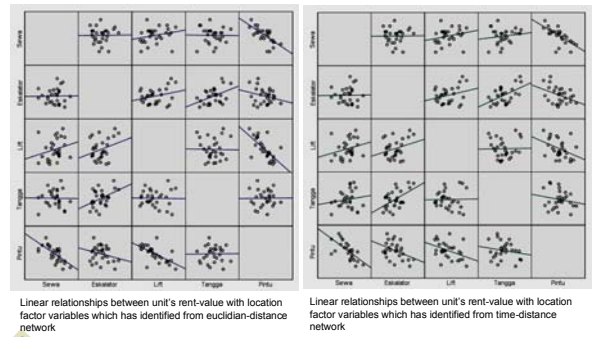
Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Variables identification using shortest path analysis



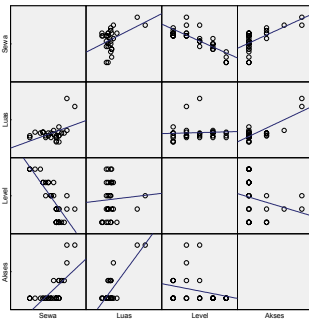
Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Variable identified by network analysis



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Variables without network analysis



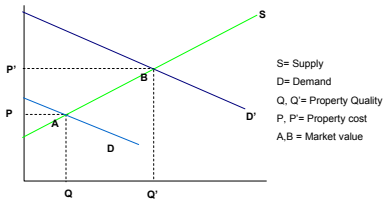
Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Conceptual Model



Market Value Comparison Approach

- Property value can be estimated from the other value and property quality that known by an adjustment
- The changing of property quality will change the supply cost of its property then change the supply line.
- Property quality can be physical and location quality.



The Curve of demand changing of property type to the supply (Eckert, 1990)

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Mathematical Model



Unit Value = f (physical character and location unit)



$$\text{Rent value} = b_0 + b_1 \text{Size} + b_2 \text{Level} + b_3 \text{Access} + b_4 \text{Entrance} + b_5 \text{Elevator} + b_6 \text{Escalator} + b_7 \text{Stairway} + e$$

Rent variable as dependent variable and variables predictor: Size, Level, Access, Entrance, Elevator, Escalator, Stairway and Toilet as independent variables. b_0 is intercept value as rent value first-approach, assumed is equal to value rent if every predictor variables has zero value and e is error variable.



$$\sum e^2 = \text{minimum}$$

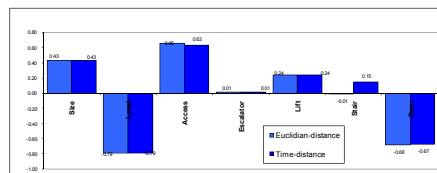
Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Variable Correlation Analysis



Pearson Correlation between rent value and predictor variable

| Correlation | Size | Level | Access | Escalator | Elevator | Stair | entrance |
|-------------------|------|-------|--------|-----------|----------|-------|----------|
| Reaching distance | 0,43 | -0,79 | 0,66 | 0,01 | 0,24 | -0,01 | -0,68 |
| Reaching Time | 0,43 | -0,79 | 0,63 | 0,01 | 0,24 | 0,15 | -0,67 |



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Regression Model Analysis

Model Summary

| | | R Square | | Adjusted R Square | | Std. Error of the Estimate | |
|-------|-------------------|----------|--------|-------------------|--------|----------------------------|----------------------------|
| Model | R | R Square | Change | Adjusted R Square | Change | Std. Error of the Estimate | Std. Error of the Estimate |
| 1 | .794 ^a | .631 | | .611 | | 115679.825 | |
| 2 | .845 ^b | .692 | .061 | .670 | .079 | 107176.571 | |
| 3 | .870 ^c | .741 | .045 | .681 | .040 | 101103.608 | |
| 4 | .892 ^d | .784 | .043 | .685 | .013 | 97571.047 | |
| 5 | .894 ^e | .786 | .002 | .685 | .002 | 97571.047 | |

Change Statistics

| Model | R Square Change | F Change | df1 | df2 | Sig. | F Change | Sig. |
|-------|-----------------|----------|-----|-----|------|----------|------|
| 1 | .631 | 46.122 | 1 | 27 | .000 | | |
| 2 | .061 | 63.168 | 1 | 26 | .000 | | |
| 3 | .045 | 20.586 | 1 | 25 | .000 | | |
| 4 | .043 | 64.630 | 1 | 24 | .000 | | |
| 5 | .002 | 7.264 | 1 | 23 | .013 | | |

Time

| | | R Square | | Adjusted R Square | | Std. Error of the Estimate | |
|-------|-------------------|----------|--------|-------------------|--------|----------------------------|----------------------------|
| Model | R | R Square | Change | Adjusted R Square | Change | Std. Error of the Estimate | Std. Error of the Estimate |
| 1 | .794 ^a | .631 | | .611 | | 115679.824 | |
| 2 | .839 ^b | .676 | .045 | .656 | .040 | 107176.569 | |
| 3 | .852 ^c | .706 | .030 | .663 | .015 | 100111.653 | |
| 4 | .890 ^d | .761 | .055 | .681 | .019 | 98818.809 | |
| 5 | .872 ^e | .746 | -.015 | .680 | -.011 | 100111.653 | |

Chosen Model

Model with higher Adjusted R and lower std. Error of the estimate (SEE) will predict the better rent value

Time

a. Predictors: (Constant), Level
 b. Predictors: (Constant), Level, Access
 c. Predictors: (Constant), Level, Access, Door
 d. Predictors: (Constant), Level, Access, Door, Escalator
 e. Predictors: (Constant), Level, Access, Door, Escalator, Elevator
 f. Dependent Variable: Rent

Time

a. Predictors: (Constant), Level
 b. Predictors: (Constant), Level, Size
 c. Predictors: (Constant), Level, Size, Door
 d. Predictors: (Constant), Level, Size, Door, Escalator
 e. Predictors: (Constant), Level, Size, Door, Escalator, Elevator
 f. Dependent Variable: Rent

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Empirical model and Regression Assumption Test

Chosen Coefficient Model

| | Unstandardized Coefficient | Standardized Coefficient | Tolerance | VIF |
|------------------|----------------------------|--------------------------|-----------|-------|
| Level (Constant) | 1468453.117 | | .392 | 2.553 |
| Level | -78646.427 | -.386 | .726 | 1.373 |
| Access | 71585.854 | .373 | .373 | 2.683 |
| Door | -4071.142 | -.195 | .400 | 2.500 |
| Elevator | -3345.632 | -.161 | .404 | 2.480 |
| Elevator | -1032.026 | -.048 | .369 | 2.709 |

Dependent Variable: Rent

Rent Value = 1.468.453 - 78646Level + 71585Access - 4071entrance- 3345Escalator - 1104L

Normal error distribution

Unstandardized Residual: 0.129 to 0.2
 Shapiro-Wilk: 0.951, 29, 0.19

Ho>Error is not normally distributed
 H1>Error normally distributed
 Significant Value >0.05 means Ho is rejected and H1 is accepted

Multicollinearity Test

| | Tolerance | VIF |
|-----------|-----------|-------|
| Level | 0.726 | 1.373 |
| Access | 0.661 | 1.513 |
| Door | 0.373 | 2.683 |
| Escalator | 0.831 | 1.203 |
| Elevator | 0.581 | 1.721 |

Multicollinearity happened when VIF>10, test result shows that VIF<10, so it can be concluded that there is no significant multicollinearity indication

Heterokedasticity Test

| | Pearson Correlation | Abs_Res |
|------|---------------------|---------|
| Rent | 0.223 | 0.237 |
| N | | 29 |

This situation causes concern because the regression model will be unduly influenced by the high-value properties and thus be less reliable when applied to low value properties. Pearson's significance > 0.05, so it can be concluded that there is no significant heteroscedasticity of empirical model.

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Model Validation

Study of Validation data Ratio:

| | |
|------------------------------|-------|
| Price Related Differential | 0,999 |
| Coefficient of Dispersion | 0,037 |
| Coefficient of Variation (%) | 5,2 |
| Median Centered (%) | 5,5 |

COV value at 5.2% (mean centered) and 5.5% (median centered) is tolerated by IAAO (<10 %). COD value at 0.037 is tolerated by IAAO (<20% for income approach). PRD value at 0.999 is also tolerated by IAAO (>0.98 dan <1.03)

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Model Application

Position lantai under ground (LUG)

Position lantai ground (LG)

Position lantai upper ground (LUG)

Position lantai 1 (G1)

Position lantai 2 (G2)

Position lantai 3 (G3)

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

The Error Source in Variable Identification

The Assumption of Error for Unit Node Representation

a. Elevator

b. Escalator

c. Stairs

d. Room Units

The Assumption of Error for Corridor Centerline

a. Intersection of bisection angle

b. Medial axis of correspondence segment

c. Center of junction polygon

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

The Error Source in Variable Identification

Aspect of line-projection of unit's node to corridor's centerline

In this research, connective line of node to corridor is based on the projection of unit's node to corridor's centerline (dot projection to line) and if it has the distance of < 0.5m from the existing nodes of corridor's centerline hence unit node interfaced to proximate the exist node. The error of variable's coefficient, which is identified by network analysis, is affected by this assumption.

Aspect of dummy-height between floors

This research assumes that the height of floor is equal for each floor in the building. It could be assumed as dummy-value, which is equal to 5 meters. This assumption will result incorrect geometric calculation on 3D network data structure as in reality the height of floor is different for each floor. However if in reality, the height between floors is same.

The error of height assumption will be not affect time-network because of the height relation of units are derived directly from the observation of the study object.

Aspect of network-weight

The weight of network could be the source of error of variable identification both of euclidian-network and time-network weight. The weight of euclidian-network, as source of error of variable identification depends on the accuracy of spatial data of the object when, the weight of time-network depends on the accuracy and consistency of time data from object.

Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

The variables which are influencing the rent-value



| No. | Variable | Euclidian network Correlation | | Time network Correlation | |
|-----|-----------|-------------------------------|------|--------------------------|------|
| | | Sign direction | Sig. | Sign direction | Sig. |
| 1 | Size | ? | No | Positive(+) | Yes |
| 2 | Level | Negative(-) | Yes | Negative(-) | Yes |
| 3 | Access | Positive(+) | Yes | Positive(+) | Yes |
| 4 | Entrance | Negative(-) | Yes | Negative(-) | Yes |
| 5 | Escalator | Negative(-) | Yes | Negative(-) | Yes |
| 6 | Elevator | Negative(-) | Yes | ? | No |
| 7 | Stair | ? | No | ? | No |

- There are variables that have same sign and significance from the model that are level, access, entrance and escalator.
- Variable of size and stairway are not significance to influence rent-value unit. Perhaps the data sample are not sufficient to be analyzed to get the significance of those variables or those variables are really not significance to influence rent-value unit.



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Empirical Model Interpretation



rent-value = 1571675-78172Level+64703Access - 5143Entrance-3409Escalator - 2048Elevator

- From the empirical model, which formed can be interpreted as follows:
- Intercept value is equal to +1.571.675, it means that the proximity of rent value at study object is equal to Rp.1.571.675/m².
 - The coefficient of variable of floor-level is equal to -78172, it means that an increase of 1 floor-level will decrease rent-value by Rp.78.172.
 - The coefficient of variable of mount-access is equal to +64073, it means that an increase of 1 access will increase rent-value by Rp.64.073.
 - The coefficient of variable of escalator is equal to -3409, it means that an increase of 1 meter distance to escalator will decrease rent-value by Rp.3409.
 - The coefficient of variable of entrance is equal to -2.046, it means that an increase of 1 meter distance to entrance will decrease rent-value by Rp.2.046.



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Conclusion



- Based on the results of identification of location factor variables, 3D network data structure has a potential to contribute in significant as a tool of rent-market-value assessment.
- Based on the result of regression analysis of euclidian-network and time-network model, the primary variables which influence rent-value is:
 - Mount of access: the coefficient has positively sign, which means an increase of access will be increase rent price.
 - Floor-level: the coefficient has negatively sign, which means an increase of floor-level will be decrease rent price.
 - Distance-to-escalator: the coefficient has negatively sign, which means an increase of the distance to escalator will be decrease rent-price.
 - Distance-to-entrance: the coefficient has negatively sign, which means an increase of the distance to the entrance will be decrease rent-price.
- The secondary variable is distance to elevator. Variable which has not influence significantly are size and stairway variables.
- Based on the results of regression analysis of euclidian-network and time-network model, the spatial relationship among units that most influencing rent-value units, is Euclidian-distance.
- Based on the results of ratio study of data validation, the appraisal's rents-value reflect rents market value.



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

Suggestion



The research has suggestions as follow:

- It is important to intensify this kind research, with same kind research's object and same kind research's method but with a large number samples to be more representing population.
- The research only used one year observation, for the best result, it is important to extending time-period of sample rents unit observation particularly when markets are stable. Even when prices are changing, the technique can be effective if rent prices are adjusted for time.
- To minimizing the error of the coefficient of location factor variables on network, it is important to analyze geometric network potential error number for each variable identification coefficient.
- It is important to study other variables, which are probably influence rent value units on multi-level commercial building.



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D

THANK YOU



Analisis variabel yang mempengaruhi nilai sewa unit bangunan komersial bertingkat berbasis struktur data jaringan 3D